



PHYSICOCHEMICAL CHARACTERIZATION AND FATTY ACID CHEMICAL PROFILE OF *COULA EDULIS* SEED OIL COLLECTED AT INERA LUKI, CENTRAL KONGO PROVINCE, DR CONGO

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Abstract: - Physicochemical characterization of *Coula edulis* oil was carried out using chemical analysis methods recommended by the Association Française des Normes (AFNOR) and the Association of Official Analytical Chemists (AOAC). The chemical profile of fatty acids in *C. edulis* oil was defined by gas chromatography.

The seeds of this plant have a medium oil content, and its acid value is within the Codex Alimentarius standards. Its iodine value is similar to that of semi-siccative oils. The saponification value of *C. edulis* seed oil is comparable to that of edible oils such as soybean, peanut and cotton. Depending on the value of its refractive index, this oil is classified as semi-siccative, like olive oil.

C. edulis oil contains a very high level of monounsaturated fatty acids, as its oleic acid content exceeds that of olive oil (*Oleo europeae*). This plant therefore needs to be industrially exploited, as it has great economic potential.

Keywords: physicochemical characterization, fatty acid chemical profile, *Coula edulis* oil.

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Introduction

Coula edulis is a plant in the Olacaceae family. It is a non-conventional oilseed that represents a very important part of the non-timber forest products (NTFP) of the forests of DR Congo. Domestication trials are already underway at the Luki station of the Institut National de Recherche Agronomique (INRA). *Coula edulis* is a medium-sized tree of the lower forest floor, reaching 30 m in height, often branching as early as 3 to 4 m from the ground. Diameter can occasionally reach 1m. The bark is gray, 1 cm thick and often rectangular, with a fibrous, brittle, yellow-brown edge. This is a species whose trees develop according to the architectural de roux ; horizontal branches appear continuously at each node of the trunk.

Leaves are evergreen, alternate, simple, with a glossy green blade on top and reddish hairs, and 10 to 13 pairs of midribs and midribs. The petiole is 1 to 3 cm long. The 4 to 6 flowers are hermaphrodite, white-yellowish or slightly reddish, 2 to 5 mm; the fruits are globular and ellipsoid, 3.5 to 5 cm in diameter, yellowish-green when ripe, weighing an average of 35g. The stone is rounded and made of hard, brown, thick endocarp covered with small projections in three directions, thickening considerably from the top. The kernel is single, spherical, 1.5 to 2.5 cm in diameter, oily, white and weighs 10 to 15g. Coulas edulis seeds are rich in fat, according to VIVIEN et al [1996] and ADRIEANS [1951].

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Source : Vivien et al, [1996]

Image1 : *Coulas edulis* plant



source : Vivien et al [1996]

Image2 : Nut of *Coulas edulis*

The aim of this study is to develop this species, an unconventional oilseed, as a new source of oils that can be used in food and industry to guarantee food safety. The study focuses on the nutritional and economic issues involved in producing renewable energies for sustainable development. The aim of this study was to update data on the physicochemical characterization of the oil from this plant, first studied in 1951 and published in a book entitled "les oléagineux du Congo Belge" and in 1975 in a thesis entitled "Contribution à l'étude chimique des plantes oléagineuses de la République du ZAÏRE" [ADRIAENS, 1951 ; KABELE, 1975].

This study is both documentary and experimental. It reviewed the literature on the chemistry of oilseeds and natural resources. It also used conventional and standardized methods of chemical analysis from AOAC [2005], IUPAC [1979] and AFNOR [1988]. Oil extraction and determination of the oils' physicochemical parameters were carried out at the Laboratoire de Chimie Organique et Energétique (LACOREN), Faculty of Science, University of Kinshasa. The chemical profile of the fatty acids was determined at the Laboratoire de Chimie des Huiles Essentielles, Université Blaise Pascal, Clermont Ferrand, France.

Material and Methods

1. Material

Coula edulis seeds were collected at Jardin Botanique de Kisantu and Station Luki in Kongo Central Province, DR Congo. Seeds were collected from July to September. Samples were authenticated by the Herbarium Department of the Faculty of Science at the University of Kinshasa.

2. Fat Analysis Methods

C. edulis seeds were ground in an electric mill (FUMA JAPAN brand, FU-250) and sieved. The oils were extracted by delipidation of the powders with n-hexane in the soxhlet, after concentration of the solvent in the rotavapor and oven drying at 103°C. The fat content of the seeds was determined in accordance with the approved French standard (NF V03-924) [AFNOR, 1981].

The physicochemical parameters of the oil were determined using the classic analytical methods described by the Association

Française des Normes [AFNOR, 1981], the Association of Official Analytical Chemists [AOAC, 2005], MAMPOUYA, [2007] and WOLFF [1968]. Two tests were carried out in accordance with the recommendations of the "Association Française des Normes" [AFNOR, 1981], and a mean with standard deviation was obtained for the results.

2.1 Determination of the fat content of different seeds in accordance with the French standard (NF V03-924)

a) Procedure

Preparation of test sample

The seeds, which had been sorted and cleaned by hand and oven-dried at 80°C, were crushed and reduced so as to pass completely through the sieve. A twentieth of the sample was used to perfect the cleaning of the grinder and the grind was rejected, the rest was crushed and collected for oil extraction. Approximately 10g of the sample was weighed to within 0.01g of the end of grinding.

Preparation of the extraction cartridge

The test sample was placed in the cartridge, which had been delipidated, dried in an oven and capped with absorbent cotton.

Preparation of the flask

The 250ml flask, containing 2 pumice seeds, was oven-dried at 103°C±2°C, then cooled for at least 1 hour in the desiccator and three-quarters filled with n-hexane.

First extraction

The cartridge containing 10g of test sample is placed in the Soxhlet extractor. The flask filled with solvent is fitted to the extraction apparatus, and the whole is placed in the heating mantle. It was heated for 4 hours, about twenty-four siphonings. After extraction and cooling, the cartridge was removed from the extractor and placed in a stream of air to remove most of the impregnating solvent.

Second extraction

The cartridge was emptied into the micro-crusher, and the contents ground as finely as possible. The crushed material was returned to

the cartridge, which was then placed in the extraction apparatus for a second extraction lasting a further 2 hours, using the same flask containing the first extraction. The solution obtained in the extraction flask was filtered onto filter paper by washing the first flask and filter paper several times with hexane. The filtrate and washing solvent were collected in a second flask, previously dried and tared to the nearest 1mg.

Removal of solvent and weighing of extract

Most of the solvent was removed by rotavapor, and the last traces of solvent were removed by bubbling with nitrogen gas and heating the flask in an oven at $103^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 20 minutes. The flask was left to cool in the desiccator for at least 1 hour, and weighed to the nearest 1mg. The flask was heated again for 10 minutes under the same conditions, cooled in the desiccator and weighed. Two determinations were carried out on the same test sample.

b) Expression of results

The hexane extract or fat content, expressed as a percentage by mass, of the product as is, is equal to : $m1 \times \frac{100}{m0}$

where :

$m0$ is the mass, in grams, of the test sample,

$m1$ is the mass, in grams, of the extract after drying.

The result is the arithmetic mean of the two determinations.

2.2 Preparation of the laboratory sample for analysis (NF T 60-200) [AFNOR, 1981].

Procedure :

The sample in its container was introduced into an oven heated to a temperature below 50°C and maintained until the sample reached this temperature. The sample was then made as homogeneous as possible by stirring the closed container. If, after heating and stirring, the sample is not perfectly clear, the oil is filtered out inside the oven maintained at 50°C . To avoid any modification of the fatty substance by oxidation or polymerization, excessively long residence times in the oven are avoided.

2.3 Determination of oil density (ISO 6883) [AFNOR,1981].

a) Procedure

The empty pycnometer was tared to the nearest 0.1mg using the thermometer and stopper. The pycnometer was then filled with the test sample and the stopper was replaced, without including any air bubbles. The filled pycnometer was placed in a hot bath at the temperature of $40^{\circ}\text{C} \pm 1^{\circ}\text{C}$ required for determination, until the contents reached this temperature. The sample was allowed to flow and wiped off at the top of the flow. The temperature was recorded; the pycnometer was removed from the water bath and carefully wiped dry with a cloth. The pycnometer was weighed when it reached room temperature of 20°C .

b) Number of determinations

Two determinations were carried out on the same test sample.

c) Expression of results

The density, $V\theta$, expressed in grams per milliliter or kilograms per liter, of the fatty substance at $\varrho\theta^{\circ}\text{C}$ is equal to : $\frac{(m2-m0)}{V\theta}$

Where :

$m0$ is the mass, in grams, of the empty pycnometer ;

$m2$ is the mass, in grams, of the pycnometer filled with fat ;

$V\theta$ is the volume, in milliliters, of the pycnometer at temperature θ .

Take as the result the arithmetic mean of the two determinations, if repeatability conditions are met, and express it to four decimal places.

2.4 Determination of refractive index (NF T 60-212 ; ISO 6320) [AFNOR,1981].

a) Procedure :

The test sample was prepared in accordance with ISO 661.

The refractometer was adjusted by measuring the refractive index of α -bromo-naphthalene.

The temperature of the prism was kept constant by means of water circulation provided by the water bath. The water temperature was monitored at the outlet of the refractometer, using a precision thermometer. Before measurement, the moving part of the prism was lowered to a horizontal position, and the prism surface wiped first with a soft cloth and then with a cotton swab moistened with a few drops of hexane. The refractive index was read to the nearest 0.0002 absolute value, noting the temperature of the prism. Immediately after measurement, the prism surface was wiped with a soft cloth and then with a cotton swab moistened with a few drops of hexane. Two further measurements were then taken and the average of the two measurements calculated.

b) Calculation method and formulas

If the difference between the measurement temperature $t1$ and the reference temperature t is less than 3°C , the refractive index n_D^t at the reference temperature t is given by the formula

$$a) \quad \text{Si } t_1 > t$$

$$n_{D=}^t = n_{D=}^{t1} + (t_1 - t) F$$

$$b) \quad \text{Si } t_1 < t$$

$$n_{D=}^t = n_{D=}^{t1} - (t - t_1) F$$

Where :

$t1$ is the measurement temperature ;

t is the reference temperature;

F is equal to

0.00035 for $t = 20^{\circ}\text{C}$;

1.36 $t = 40^{\circ}\text{C}$ and $t = 60^{\circ}\text{C}$

The result is the arithmetic mean of the values obtained for the two determinations in the repeatability condition.

2.5 Determination of Saponification value (NF T 60-206) [AFNOR,1981]

a) Procedure

The sample was prepared in accordance with standard NFT 60-200 and the saponification number on the fatty substance was determined perfectly anhydrous and filtered. In a conical flask, 2g of fatty substance were weighed to the nearest 0.001g. Exactly

measured 25ml of ethanolic potassium hydroxide solution was added to the flask containing the test sample, and the flask was fitted to the cooler, then brought to a gentle boil with occasional stirring.

After sixty minutes, heating was stopped. 4-5 drops of phenolphthalein solution were added to titrate the still hot soap solution with hydrochloric acid. Two determinations were carried out on the same prepared sample. A blank test was carried out under the same conditions.

Expression of results

The saponification number is equal to : $((V_0 - V_1) \times T \times 56.1) / m$

Where:

V_0 is the volume, in milliliters, of the hydrochloric acid solution used for the

The blank test ;

V_1 is the volume, in milliliters, of the hydrochloric acid used for the determination;

m is the mass, in grams, of the test sample,

T is the exact titre of the hydrochloric acid solution used.

The result is the arithmetic mean, without decimal places, of the two determinations under repeatability conditions.

2.6 Determination of iodine value (NF T 60- 203) [AFNOR, 1981].

a) Procedure

The sample was prepared in accordance with standard NF T 60-200. The sample was weighed into the 300ml flask at 0.12g. 15ml of carbon tetrachloride was introduced to dissolve the fat. Next, 25ml of iodine monochloride was introduced. The flask containing the test sample and reagents was stoppered, shaken gently and placed in a dark place at a temperature of $20^\circ\text{C} \pm 5^\circ\text{C}$ for one hour.

After this time, 20ml of the aqueous potassium iodide solution and 150ml of distilled water were added. Next, titration was performed with 0.1N sodium thiosulfate solution, using starch as an indicator. After very vigorous stirring, titration was continued until the blue color disappeared. Two determinations on the same prepared sample. This was followed by a blank test, without the fatty substance, under the same conditions.

b) Expression of results

The diode index is equal to : $12,69 \times T \times \frac{(V_0 - V_1)}{m}$

Where :

V_0 is the volume of sodium thiosulfate solution used for the blank test,

expressed in milliliters.

V_1 is the volume of sodium thiosulfate solution used for the sample, expressed in milliliters.

m is the mass, in grams, of the test sample,

T is the exact titre of the thiosulfate solution used.

2.7 Determination of acid value and acidity (titrimetric methods, ethanol method) (NF T 60-204) [AFNOR, 1981].

a) Procedure

The test sample was prepared in accordance with standard NF T 60- 200. A 10g test sample was taken in a conical flask, with the acid value ranging from 1 to 4. The test sample was dissolved in 100ml of ethanol previously neutralized (carefully brought to near boiling point before use) with ethanolic potassium hydroxide solution in the presence of 0.03ml phenolphthalein solution per 100ml until a persistent faint pink coloration was obtained.

With vigorous stirring, potassium hydroxide solution at 0.1mol/l was titrated until the indicator changed color.

Two determinations were carried out on the same test sample.

b) Expression of results

The acid number is equal to: $(56.1 \times V \times C) / m$

Where:

V is the volume, in milliliters, of the potassium hydroxide standard solution used;

C is the exact concentration, in moles per liter, of the potassium hydroxide standard solution used;

m is the mass, in grams, of the test sample.

2.8 Determination of peroxide value (NF T 60-220) [AFNOR, 1981].

a) Procedure

2.0g of fat was weighed into a glass scoop according to the peroxide value of 0 to 150 in micrograms of active oxygen per gram of fat. The bottle was uncorked and the basket inserted. 10ml of chloroform were added to quickly dissolve the fatty substance, shaking the bottle. A further 15ml of acetic acid was added, followed by 1ml of potassium iodide solution. The flask was immediately capped and shaken for one minute, then left for five minutes in the dark. Next, approximately 75ml of distilled water was added. The mixture was titrated with vigorous stirring. The ion thus liberated, thanks to the 0.01N sodium thiosulfate solution, was detected using starch as an indicator. Two determinations were carried out on the same sample.

Afterwards, a blank test was carried out without the fatty substance. b) Expression des résultats

The peroxide value, expressed in micrograms of active oxygen per gram, is equal to :

$$8000 \times V/E$$

Where :

V is the volume of sodium thiosulfate solution used for the test, corrected for the blank test, expressed in milliliters of solution N.

E is the mass, in grams, of the test sample.

The result is the arithmetic mean of two determinations.

2.9 Determination of fatty acid composition.

Determination of the chemical composition of fatty acids was carried out at the Clermont Ferrant Laboratory in France. It was

carried out by gas chromatography, the most suitable method [SKIERA, 2012; WOLFF, 1968].

Gas chromatography is a method for separating compounds that are gaseous or can be vaporized by heating without decomposition of the product. Its principle is based on the concentration equilibria of compounds present between two immiscible phases, one of which, known as the stationary, non-volatile liquid, is trapped in a column, while the other, known as the mobile phase (inert gas: H₂, N₂, He) moves in contact with the first phase, carrying the solute.

A flame ionization detector (FID) detects the different compounds as they exit the column. The constituents of the mixture leaving the column one after the other are identified and assayed, and the signals they produce at the detector are translated at a recorder by a succession of peaks (chromatogram), characterized by a retention time (identification) and an area (assay). Fat analysis is thus a two-stage process: separation of the products contained in the fat and identification of these products, preceded by release of the TAG-forming GAs by methanolysis

9.1. Preparation of methyl esters.

The fatty acids making up the fatty acylglycerols are liberated by basic transmethylation with a methanolic sodium hydroxide solution.

0.4 ml methanolic soda solution (1 N) is added to 2 drops of oil previously dissolved in 1 ml n-hexane ; after stirring and heating for less than a minute, 0.4 ml hydrochloric acid (1 N) and 1 ml hexane are added. The organic phase is recovered for analysis.

a) Separation by gas chromatography

Analyses were carried out using an HP 5890 chromatograph equipped with an apolar column (HP 5M, 30 m long, 0.25 mm internal diameter and 0.2 µm thick) and a FID detector (Flame Ionization Detector) under the following experimental conditions:

- Carrier gas, helium at constant flow: 1 ml/mm
- furnace temperature: programmed from 50 to 280°C, with a 5°C/min gradient
- injector temperature: 250°C
- detector temperature: 280°C
- quantity injected: 1 µl.

b) Identification of fatty acids

Fatty acids are identified by their respective retention times.

Fatty acids are determined via their methyl esters using the internal calibration method.

A known quantity of heptadecanoic acid (C17:0) is added to the fat under study, and the fatty acids contained in the fat under study are determined by comparing their areas with that of C17:0 as follows:

$$GA \text{ (mg)} = \text{mass (C17 :0)} \times [\text{Area (GA)} / \text{Area (C17 :0)}]$$

$$\% GA = GA \text{ (mg)} \times 100/\text{total GA (mg)}$$

c) Interpretation of results

When interpreting results, it's important to remember that fats are natural products, and that their composition therefore depends on many parameters.

For example, for vegetable fats, plant variety and location affect composition. In the case of animal fats, factors such as sex, age, breed, etc. have a direct impact on composition. Food and rearing region are to be taken into account. For fish, parameters such as season and fishing region must be considered [WOLFF, 1968].

Means and standard deviations were obtained using Excel 2010. They were used to describe the data. The arithmetic mean satisfactorily describes the data in this publication: $\langle x \rangle = (\sum x_i/n)$, for n values of x_i . The dispersion of a data set can be perceived in different ways, and in particular by the amplitude between the minimum value and the maximum value. However, standard deviation is the most widely used parameter. It has the advantage of considering each experimental value in relation to the mean. It is given by the relation: $\sigma = \{[\sum (x_i - \langle x \rangle)^2]/n-1\}^{1/2}$.

2. Results and Discussion

2.1 Physicochemical characterization of oils extracted from *Coula edulis* seeds

The results concerning extracted fat contents and physicochemical fat indices of non-conventional oilseeds are given in Table 1.

Table 1: Fat content and physicochemical indices of *Coula edulis* seed oil

Parameters	Value
Fat content (%)	25.0 ± 0,1
Acid value (mg KOH/g oil)	3.5 ± 0,1
Density (15°C)	0.9154 ± 0,0
Iodine value (g iodine/100g oil)	103.3 ± 0,1
Peroxide value (meq O ₂ /kg oil)	65.0 ± 0,1
Saponification value (mg KOH/g oil)	191 ± 0,0
Refractive index (20°C)	1.496 ± 0,0

The results of fat content and physicochemical index determinations are shown in Table 1. An oilseed plant can only be used for industrial purposes once its fat content exceeds a certain threshold. This is why, in practice, only those plants that exceed this threshold are considered oilseeds. Conventionally, this threshold is set at 15 - 20% fat content. LOUMOAMOU [2011] distinguishes between plants with low (< 20%), medium (20-50%) and high (> 50%) fat content. *C. edulis* seeds contain 25.0±0.1% fat; this result differs from that of ADRIAENS [1951] with 29.6% fat, a value that could not be higher than that of this study. We can see that the fat content of *C. edulis* seeds falls within the 20-50% range of oilseeds with medium oil content. It is therefore an oilseed species with a medium oil content, which could be of economic interest for development or exploitation.

Measurement of the fatty acid number is one of the best ways of assessing natural alteration by hydrolysis in fatty acids [WOLFF, 1968]. It also plays an important role in determining the quality parameter in the production, storage and official control of edible oils [SKIERA C, 2012]. The acid value of *C. edulis* seed fat is 3.5± 0.1mg. The acid value of *C. edulis* fat is within the acceptable standard of the Codex Alimentarius Commission (maximum

recommended is 4mgKOH/g oil [CODEX ALIMENTARIUS ,1993].

The fat density of *C. edulis* seeds is 0.9154, which does not agree with MENSIER's result [cited by KABELE ,1975], 0.8979 at 78°C. The difference may be explained by the period of collection, maturity, seed storage and also by analysis conditions.

The iodine (II) index evaluates the richness of unsaturated fatty acids. It also enables oils to be classified into three categories: non-siccative oil (low unsaturated oil, $75 \leq II \leq 100$), semi-siccative or low unsaturated oil ($100 \leq II \leq 150$) and siccative oil: highly unsaturated oil ($150 \leq II \leq 190(200)$) [FAO and WHO cited by MALUMBA [2009].

The iodine value obtained from *C. edulis* oil of 103 ± 0.1 mg in this study does not agree with that of ADRIAENS [1951], 88mg. This difference may be attributed to working and analytical conditions. The chemical or biochemical reaction may re-form conjugated double bonds or triple bonds, or the contact time may not be long enough for iodine fixation in the fat studied [MORDRET,1992]. This value is within the range of semi-drying oils, the value of an edible oil.

The peroxide value (PI) can be used to check the rancidity of an oil. However, this is not a reliable method, as rancidity products can be destroyed at 130°C. Rancidity produces peroxides when the unsaturated fatty acid content is too high; then, by breaking the chain, aldehydes responsible for the rancid odor and acids (all toxic) are formed [WOLF, 1968]. The peroxide value of *Coula edulis* oil is 65.0 ± 0.1 meq O₂/kg oil. This oil has a very high peroxide value. This peroxide value is not comparable with the maximum acceptable value of 10 set by the Codex Alimentarius Commission for Edible Oils, and shows that this oil cannot resist peroxidation during storage.

The saponification index (SI) provides information on the average length of fatty chains. It varies inversely with the molecular weight of the glyceride making up the fat. The saponification value of *C. edulis* seed oil is 191mg KOH/g oil. This is comparable to the saponification indices of food oils such as soybean (189-195mg KOH/g oil), groundnut (187-196mg KOH/g oil) and cotton (189-198mg KOH/g oil) [FAO, 1981].

The refractive index (η) is linked to unsaturation and depends on free acidity, oxidation, polymerization and the existence of secondary functions on the molecule (with polymerization, an edible oil becomes altered, degraded, rancid and thus loses its food properties). Finally, the refractive index (20°C) is 1.496 ± 0.0 for *C. edulis* oil. A comparison with the refractive index of the same oil studied by ADRIAENS [1951] reveals a significant difference. The saponification index (SI) provides information on the average length of fatty chains. It varies inversely with the molecular weight of the glyceride making up the fat. The saponification value of *C. edulis* seed oil is 191mg KOH/g oil. This is comparable to the saponification indices of food oils such as soybean (189-195mg KOH/g oil), groundnut (187-196mg KOH/g oil) and cotton (189-198mg KOH/g oil) [FAO, 1981].

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C. edulis oil. A comparison with the refractive index of the same oil studied by ADRIAENS [1951] reveals a significant difference. This shows that refractive index measurements were not carried out under similar conditions. *C. edulis* oil is classified as a semi-siccative oil, as its main fatty acid is oleic acid, whose percentage exceeds that of olive oil. The results on the chemical profile of the fatty acids making up this oil are shown in the following table:

Table 2: Fatty acid composition of oil methyl esters of *Coula edulis*

Esters AG	Simplified formulas	Percentage
Myristate (%)	14 :0	0,04
Palmitate (%)	16 :0	1,74
Heptadecanoate(%)	17 :0	0,04
Stearate(%)	18 :0	1,64
Oleate(%)	18 :1, n-9 cis	92,62
Linoleate(%)	18 :2, n-6	0,8
Linolenate(%)	18 :3, n-3	1,1
Arachidate(%)	20 :0	0,19
Cis-11-Eicosenoate (%)	20 :1, n-9	0,81
Behenate(%)	22 :0	0,05

The results of the determination of the chemical profile of fatty acids in *C. edulis* seed oil are commented and discussed according to the data reported in table2.

The fat content of *C. edulis* seeds is high in oleic acid (92.2%), but lower in linoleic acid and linolenic acid (0.8% and 1.1% respectively). This result differs from that described by ADRIAENS [1951] with 1.6% saturated fatty acids, 87.1% oleic acid and 2.7% linoleic acid. This difference may be due to the influence of the soil and/or the working conditions of the analyses, which were not the same.

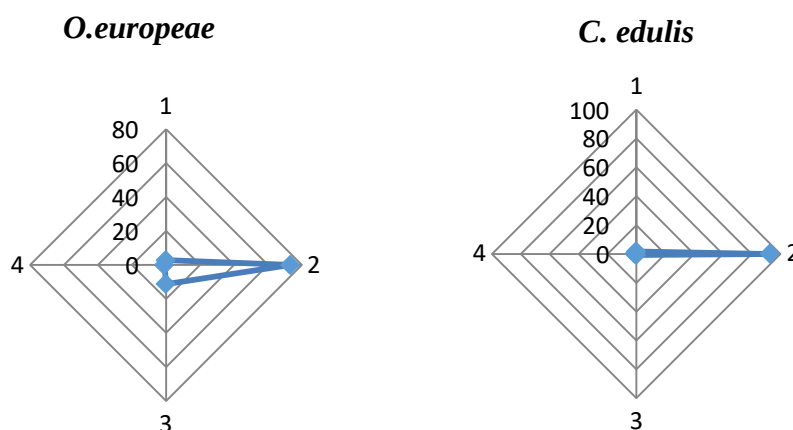
However, both the results of this study and those of Adriaens show that *C. edulis* seed is a unique source of oleic fatty acid. *C. edulis* oil has an oleic acid content (92.2%) which exceeds that of olive oil (*O. europaeae*) 73.3% oleic acid [FEINBERGM., et al ,1987].

These results are of great nutritional significance. The fatty acids identified fall into three families : saturated fatty acids 3.7%, monounsaturated fatty acids 93.43% and polyunsaturated fatty acids 1.9%.

Coula edulis oil also contains a very high level of monounsaturated fatty acids, accounting for 93.43% of its lipid content. A diet rich in monounsaturated fatty acids is linked to a reduced risk of cardiovascular disease. A study by BENDINELLI [2010] showed that people who consumed 2 tablespoons of olive oil a day (30ml) were 44% less likely to develop cardiovascular disease than those who consumed 1 tablespoon or less. Another study by CECILIA SAMIERI [2011] also showed a 41% reduction in the risk of cardiovascular stroke in high consumers of olive oil.

C. edulis oil has the same chemical profile as *Oleo europaeae* oil. This shows that the consumption of *C. edulis* oil has the same nutritional value as olive oil, because both have the same morphograms according to the following radar plots.

Polar coordinate representation (radar plots) of *C. edulis* and *O. europeae* oil, based on four main fatty acids of nutritional interest.



Legend : 1 : stearic acid; 2 : oleic acid; 3: linoleic acid; 4: linolenic acid

Figure 1 : Morphograms showing the degree of similarity between *C. edulis* and *O. europeae* oils.

The two morphograms are similar, but the figure for *O. europeae* oil is an acute triangle whose apex is occupied by oleic acid, whose concentration is on the last line of the 80% morphogram, yet the percentage of oleic acid is on the last line of the 100% morphogram. *C. edulis* oil therefore has a higher oleic acid concentration than Oleo europe oil.

Conclusion

The updating of data by determining the physicochemical parameters and defining the chemical profile of *Coula edulis* seed oil has shown that the average oil content of this plant's seed is similar to the value reported in the literature. This result makes it economically attractive to exploit. Furthermore, *C. edulis*' fat acid value is within the Codex Alimentarius Commission standard.

The density of *C. edulis* seeds is not in line with the literature. The iodine value obtained from *C. edulis* oil is not consistent with the literature. This oil has a very high peroxide value. The saponification value of *C. edulis* seed oil is comparable to the saponification values of food oils such as soybean, peanut and cotton.

Finally, the refractive index value presented in the literature shows a significant discrepancy. With this refractive index, *C. edulis* oil can be classified as a semi-drying oil, as mentioned above for the iodine index. As far as the chemical profile is concerned, it should be noted that *C. edulis* oil has the same chemical profile as Oleo europeae oil. Consumption of *C. edulis* oil is likely to have the same nutritional value as olive oil. These two oils show similar morphograms according to their radar plot figures.

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